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Source: *Human Ecology*, Vol. 40, No. 3 (JUNE 2012), pp. 405-414

Published by: Springer

Stable URL: <http://www.jstor.org/stable/41474670>

Accessed: 11-09-2016 18:17 UTC

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Pangnirtung Inuit and the Greenland Shark: Co-producing Knowledge of a Little Discussed Species

Carlos Julián Idrobo · Fikret Berkes

Published online: 22 May 2012
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Abstract When faced with a species that is seldom encountered or discussed, can local or indigenous people piece together their accumulated experience to make inferences about the ecology of that species? In this paper the Greenland shark acts as a model to study how the Inuit of southern Baffin Island are able to produce ecological knowledge. We examine experiential information, reflections, variations in knowledge, and sense-making related to the Greenland Shark, and present a knowledge co-production process based on heuristic reasoning. The process of knowledge co-production has similarities to fuzzy logic, and highlights the adaptability and versatility of indigenous knowledge systems to generate new understandings about the species and its role in the Arctic marine environment. Interactions between the Inuit and researchers can provide a forum to facilitate knowledge co-production, and can be used as a strategy to engage the Indigenous and traditional peoples in resource management and conservation.

Keywords Indigenous knowledge · Inuit · Co-production of knowledge · Fuzzy logic · Greenland shark · Arctic ecosystems · Baffin Island · Cumberland Sound · Iqalukjuak

Introduction

Local and traditional knowledge do not embrace all species in the environment of any population. Even in the case of the Inuit, who are rightly famous for their detailed species-

by-species local knowledge (Freeman 1993; Hart and Amos 2004), there may perhaps be surprising gaps in knowledge regarding certain species. When faced with a species that is seldom encountered or discussed, can local or indigenous people piece together their accumulated experience to make inferences about the ecology of that species and its role in the ecosystem? How indigenous people deal with complexity to arrive at holistic views of their environment has been interpreted in terms of fuzzy logic (Berkes and Kislalioglu Berkes 2009; Peloquin and Berkes 2009). Researchers also may play a role in stimulating discussion to synthesize available local knowledge in order to construct new understandings. Davidson-Hunt and O’Flaherty (2007) have commented that collaborative research, with researchers and indigenous experts acting in a respectful partnership, has the potential to build dynamic processes for the co-production of locally relevant knowledge.

Researchers typically draw from local knowledge, linguistic cues, belief systems, modes of communication and narratives to generate an understanding of how indigenous knowledge develops (Turner and Berkes 2006) and how it is transmitted (Pearce *et al.* 2011). Further, the increasing use of collaborative research can result in the formation of “communities of learning” for the co-production of knowledge (Davidson-Hunt 2006; Robson *et al.* 2009). Armitage *et al.* (2011: 996) define knowledge co-production as “the collaborative process of bringing a plurality of knowledge sources and types together to address a defined problem and build an integrated or systems-oriented understanding of that problem.” Such knowledge co-production and the social learning that it entails have significance for a wide range of areas, including resource management, biodiversity conservation, and adaptation (Berkes 2012). It is especially relevant in the context of social learning as adaptation, for example, in the process of adapting to environmental change (Laidler *et al.* 2009; Peloquin and Berkes 2009).

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Our case involves the Greenland shark (*Somniosus microcephalus*; *Iqalukjuaq* in Inuktitut), the only shark species normally resident in the Eastern Arctic. Even though it is one of the largest fish species that inhabits Eastern Arctic waters, little is known about the Greenland shark, perhaps due to the fact that it lives in deep waters and that there is little commercial interest in it (Skomal and Benz 2004; Yano *et al.* 2007). From an Inuit knowledge point of view as well, little is known. There are no systematic studies that document the Greenland shark from an Inuit perspective. The few accounts available in the ethnographic literature do not provide much insight on Inuit understanding of the shark (Randa 1994; Bennet and Rowley 2004). This apparent lack of documentation does not necessarily reflect an absence of Inuit knowledge but rather the fact that it is not often mentioned by the Inuit themselves and has not been a priority for Inuit knowledge research.

The Inuit from the community of Pangnirtung in southern Baffin Island, however, have had relatively greater exposure to this species due to the long-line fishery that began in 1987 for Greenland halibut (*Reinhardtius hippoglossoides*), locally called “turbot” (Treble 2008; Dennard *et al.* 2010). This is a small-scale commercial fishery in which sharks are frequently caught as a by-catch. So at least some Pangnirtung Inuit have encountered the shark, but these interactions have been based neither on use nor on cultural significance. This may explain why Inuit ecological knowledge research seems to have no references to this species (e.g., Kilabuk 1998; Hay *et al.* 2000; Hart and Amos 2004; Noongwook *et al.* 2007), and neither does the *Nunavut Wildlife Harvest Study* (Priest and Usher 2004).

Outside the context of the Greenland halibut fishery by-catch, Inuit encounters with sharks are limited. Usually they occur when the sharks scavenge caught animals such as seals in seal nets. The Greenland shark is a species that the Pangnirtung Inuit neither like nor are interested in based on the practical absence of cultural constructions and oral tradition related to this fish and what the Inuit themselves say about it (Idrobo 2008). This is in contrast to uses given to the same species in Iceland, where its meat is fermented and considered a delicacy known as *kæstur hákarl* (Weichselbaum *et al.* 2005), or in Greenland, where it is used as dog food (Marquardt and Caulfield 1996).

Here we present available Inuit knowledge about the Greenland shark and analyze what and how the Pangnirtung Inuit think about this fish species. Beyond adding to the literature on the shark and Inuit knowledge of it, we argue that our findings are relevant to understanding how an indigenous group applies its ways of knowing and general ecological knowledge to generate new knowledge in regard to a species that is neither used nor considered desirable. We analyze the process of knowledge co-production and speculate on its significance for a number of applied areas.

Following the study area background and methods, the paper is organized in three main sections. The first deals with

what is commonly known about the Greenland shark and variations in Inuit ecological understanding about the Greenland shark and discusses knowledge related mainly to experiential information, reflections about sharks, variation in knowledge, and sense-making by the Pangnirtung Inuit. The second section is about the knowledge co-production process, the heuristic reasoning of shark-related information, and provides a glimpse of the processes by which indigenous knowledge experts, using general knowledge of their ecosystems, are able to interpret and co-produce knowledge from limited experience and data on a little-known species. The discussion section considers the relevance of fuzzy logic and the role of researchers in stimulating knowledge co-production through communities of learning. Interaction between the Inuit and researchers can provide a forum to facilitate knowledge co-production, and can be used as a strategy to engage the Inuit in resource management and conservation. It may be relevant for a number of other fields as well.

Study Area, Background and Methods

The community of Pangnirtung is located on the Pangnirtung Fjord, the northeast side of Cumberland Sound, in southeastern Baffin Island, Canada (66°08'N; 65°41'W). Pangnirtung was settled in 1921 when the Hudson Bay Company (HBC) established a trading post. The settlement grew when the Canadian Government established a detachment of the Royal Canadian Mounted Police (RCMP) in the 1940s, and in the early 1960s when a distemper outbreak killed nearly all of the sled dogs in the Cumberland Sound area, which forced the Inuit living in Cumberland Sound area to relocate to Pangnirtung Hamlet (Stevenson 1997). At the time of the study, Pangnirtung had a population of about 1325 people.

The main sources of income in Pangnirtung are the government service economy, the Greenland halibut (“turbot”) fishery, the Uqqurmiut Centre for Arts and Crafts, and outfitting for Auyuittuq National Park, which employs local Inuit as guides. The subsistence economy is considered strong, and much of the community’s protein comes from local harvests (Priest and Usher 2004). Local environmental knowledge, such as that about sea-ice, is detailed and has been used to inform climate change studies (Laidler *et al.* 2008). The halibut fishery is carried out in winter from shore-fast ice. Since it is dependent on having firm ice, it has been dwindling due to unpredictable ice related to climate change. Indeed, of the 115 Inuit who used to fish on the Cumberland Sound land-fast ice during the mid-1990s (Treble 2008), no more than 10 were active in 2008. As of 2012, a boat-based summer fishery is being planned.

This research was carried out with the elders and active hunters from Pangnirtung, facilitated by the local Hunters

and Trappers Association. Participant observation, open-ended and semi-structured interviews, and a focus group were employed as research methods. Participant observation facilitated rapport with the research collaborators, and provided a context to examine information gathered in the field and during the interviews (Bernard 2006). Participant observation was carried out during hunting and fishing journeys, as well as during time spent in the community, both in the summer 2007 (early August - late September) and spring 2008 (April). We identified research collaborators following advice from the Pangnirtung Hunter and Trappers Association and the interpreter. A total of 16 interviews were conducted, 15 in Inuktitut and one in English. Of the interviewees, 14 were male and two female. The men were elders and active hunters considered knowledgeable in coastal hunting and fishing. The two women were invited to participate in this research because of their locally renowned knowledge of oral tradition.

The interview strategy followed an adaptive approach (Creswell 2009). The first seven interviews were open-ended, allowing the identification of topics relevant to the overall research (Hammersley and Atkinson 2005). Once these topics were identified, semi-structured interviews were conducted with the rest of the collaborators. The latter interviews were structured into two main sections: conversations about the interactions between the Inuit and sharks, and interactions between sharks and other sea animals. Interviews averaged 1 h and were digitally recorded. A copy of this material was deposited in the Angmarilik Cultural Centre (Pangnirtung, Nunavut) in DVD format.

At the end of the first field season, a focus group was carried out with the three interviewees who appeared to be most knowledgeable and motivated. This session allowed a review and elaboration of information obtained in individual interviews. In the second field season, there was firm ice and several members of the shark research team participated in the halibut fishery. A second verification session, carried out in year two with a group of English-speaking local fishers, produced results consistent with the first. All interviews were digitally recorded and transcribed. Content analysis was used to identify and organize the recurrent topics that emerged from the research, which were then used as “filters” to structure the presentation of research results (David and Sutton 2004). Additional details of methodology may be found in Idrobo (2008).

Pangnirtung Inuit Interactions with the Greenland Shark

Interactions with the shark were mainly limited to the Greenland halibut fishery, a bottom-set long-line fishery in which the shark is a by-catch that slows down the retrieval of the line and the harvest of halibut (Idrobo 2008). We

identified two categories of Inuit knowledge about the shark: what is commonly known about the species, and variations in Inuit knowledge about the species. The first relates to direct observations made about sharks and other firsthand knowledge that has become part of the community's accepted understanding of the species. There was general agreement about observational knowledge among Inuit research collaborators. The second relates to the knowledge produced by inferences drawn mostly from observational information. There were differences among Inuit knowledge-holders regarding the way in which observational knowledge was interpreted.

Common Knowledge of the Greenland Shark

Examples of common shark knowledge among the Pangnirtung Inuit included features such as the anatomy, including the skeletal structure, of the shark, the fact that they do not die easily, the poor eyesight/strong sense of smell complex, bite strategies, stomach contents, and patterns of abundance during the halibut fishery (Table 1). These direct observations also furnished the reasons why sharks were not considered edible: they are known scavengers, eating dead animals including those hunted and left in the water; they are perceived as unnaturally hard to kill; and the flesh quivers even after the shark is cut up (more details, Idrobo 2008).

Table 1 shows that, in spite of the apparent Inuit indifference towards the shark, there is in fact a certain knowledge base that is shared and accepted in the community. Elements of this knowledge base, such as “sharks do not have true bones” or “poor eyesight and powerful sense of smell,” reveal aspects of the biology of this species that makes it unique when compared with better known species or those with which people have more regular contact. Other aspects, such as “sharks do not die easily” and “sharks' flesh has a hard time dying” seem to reveal why the Inuit are repulsed by shark meat and why it is not included in the local diet.

More important, these general observations about sharks' biological features on which research collaborators agreed upon, served as take-off point to discuss sharks in more depth. Inferred ecological knowledge about the sharks unfolded from the observational information. But there was no general agreement among the Inuit about these inferences; rather, it was a production of knowledge that one hunter referred to as a “conscious guesswork practice.”

On Inuit Sense-making and Variations in Knowledge of the Greenland Shark

Through the articulation of the available observations about the Greenland shark with their general knowledge of the sea environment, the Pangnirtung Inuit generate a dynamic understanding of the shark and its habitat. The Pangnirtung

Table 1 Commonly known areas of Inuit knowledge on the Greenland shark

Topic	Description	Representative Quote
Sharks do not have true bones	Pangnirtung Inuit recognized that the Greenland shark has no bony skeleton.	"Sharks don't have bones at all They have cartilage where bones should be. My father used to just chop the whole animal up. He fed the whole thing to the dogs."
"Sharks do not die easily" and "they are hard to kill"	Shark flesh keeps moving long after they are pulled out of the water and even cut into pieces.	"Dad used to say to me that sharks' flesh has a hard time dying. The shark can be rotten, even sticky rotten, and when you touch the skin or the meat it still moves. You know, it is still alive but it is rotten."
Poor eyesight and powerful sense of smell	Sharks have poor eyesight, which is compensated with a strong sense of smell that helps them to find food. Poor eyesight is related to the parasitic copepods (<i>Ommatokoita elongata</i>) attached to sharks' eyes and their always-bloody snouts.	"They [sharks] are always moving in the water and smell very quickly. If something is smelly, they'll find it very quickly, although they are almost blind."
Bite strategies	Shark's jaw is a very dexterous tool for ripping seals out of the seal nets and destroying Inuit catches of seal and beluga whales.	"When I'm touching the head, I just can't imagine that this animal can do that kind of damage or be that efficient. But when I look at the teeth, I see that it can be that efficient. They don't just bite and grab; they grind back and forth. They can cut like a saw."
Diet and physiology	Sharks digest food slowly. These observations were connected to general inferences about the lethargic behavior of this species.	"They must be cold blooded. When my father cut the shark and looked at its stomach content, I could see that it (the food) was not really digested. It didn't look like in mammals, as if it had been cooked. It didn't look like it had come from a kettle."

Inuit have known about the sharks' existence long before they became a by-catch in the halibut fishery; the fishery allowed fishers to update their knowledge with new information due to an increase in interactions with the shark. Through discussions of this new evidence, different versions of the ecological understanding about the shark came to be created. Abundance and times of appearance, habitat and feeding behavior were topics of discussion among Pangnirtung hunters and elders (Table 2).

Quotations from the Inuit provide a glimpse of their modes of thinking and reasoning. When these comments are shared among the Inuit, a comprehensive picture of shark ecology begins to emerge (Table 2). It is more detailed than the commonly known biology of the shark (Table 1), but it is also more speculative, and interpretations among Inuit knowledge-holders begin to vary. For example, there was agreement about the times when sharks are caught in the Cumberland Sound (experiential knowledge), but the explanations varied (Table 2). Some seem to think that sharks had a natural migration pattern that included Cumberland Sound. Others thought sharks may be permanent dwellers in the area. Yet others speculated that sharks were lured to the area by fishing activity.

Other examples of Inuit sense-making and knowledge variations can be found in the way shark habitat and feeding behavior are understood (Table 2). Sharks habitat cannot be known through experiential knowledge, yet Inuit experts make sense of the limited information available to them in order to explain, for example, whether sharks are bottom dwellers or free swimmers that can adapt to depth and

pressure change. For those who conceive sharks as bottom dwelling creatures, sharks travel along the seabed searching for food. If the object in which sharks are interested is close to shore, sharks will reach it by following the seabed. Others think that sharks can move freely within the water column, although they spend most of their time at the bottom of the sea. Evidence of this assumption comes from the fact that the shark body shape apparently does not change when it is brought to the surface. Fishers know that many bottom fish species, such as the roundnose grenadier (*Coryphaenoides rupestris*), die when pulled up to the surface from the deep (over 1,000 m) waters of Cumberland Sound. The eyes of these fish explode and their body shape changes because the swim bladder expands. If sharks do not die when brought up to the surface and their body shape does not change, then it is reasoned that they are able to swim freely within the water column.

Through the co-production of knowledge related to the shark some Inuit were able to construct maps of ecological relationships, indicating individual variation in the way knowledge is interpreted and displayed (Fig. 1). The Inuit are keen observers of ecological relationships and some of their knowledge has guided ecological research by scientists (Freeman 1993). Discussing marine food webs offers an instance in which researchers and Inuit knowledge holders are able to produce new knowledge through their interaction. The research participants did not conceptualize marine food webs *per se*. However, by asking "who eats who and who is not eaten by anybody else?" different relationships among the species of the local ecosystem are elicited. As different

Table 2 Ecological knowledge of the Greenland shark and its variations in interpretation

Topic	Available explanations	Representative Quote
Abundance and occurrence	Migration patterns	“What I have noticed is that sharks seem to come in cycles or waves. There are long stretches of time where we didn’t catch any shark at all. That was good. Then we would start catching one, sometimes even two in the same line.”
	Permanent dwellers of the Cumberland Sound	“Looking at the number of sightings of an animal that doesn’t need air to breath, it is easy to think that there must be a lot of them down there [in the Sound]. We see so many of them, even though they don’t need to breathe air. There is no reason for them to go up into the air. I think there are a lot of sharks around, all over the place, all year round.”
	Lured to the area by fishers	“When there is more bait in the water, it can attract more sharks.”
Habitat	Bottom dwellers	“They [sharks] stay at the bottom and occasionally will follow the bottom to shallow areas.”
	Free swimmers that can adapt to changing depth and pressure	“Its [shark’s] body doesn’t change. Either at the bottom or up here, it is the same. Other fish basically blow up. Because there is so much pressure at the bottom of the sea, when you bring them up here, these fish just burst. But sharks have no problem at all. They are both real deep water and surface animals. They are just fine.”
Feeding Behavior	Scavenger	“They [sharks] try to eat anything they smell and touch. Sharks are not selective. Whatever they smell and it is close to their mouths, they’ll eat it. You can’t really say that they eat something specific, because they don’t care.”
	Opportunistic predator	“Mother seals give birth on the ice, in a den, out of the water. They don’t give birth in the water. However, their blood may trickle down there. I see how that can happen. You also see baby seals [coming from shark stomachs]. Sharks must catch them [baby seals] alive. They are quite capable of getting a live one.”
	Active predator	“I have hunted ringed seals on the ice. A couple of them had horrible wounds, perfectly round wounds on them” ... “In winter, they [ringed seals] have small breathing holes. So the seal was probably at the breathing hole when the shark bit it.”

research collaborators elucidate these associations the understanding of the local marine food web that emerges shows variations by participant. The kinds of relationships mapped in Fig. 1 are known to many of the experienced Inuit knowledge-holders. However, it must be emphasized that these maps are not consensus documents. Rather, they are the personal maps of two particularly knowledgeable research participants. They do locate the Greenland shark in the overall web of relationships, the co-produced part of the figure. The two maps are similar in broad outline but different in detail. Hunter A shows more detail, including opportunistic predation of sharks on bearded seal (*Eringnathus barbatus*). Hunter B shows fewer species and interactions but notably includes opportunistic cannibalism among Greenland sharks.

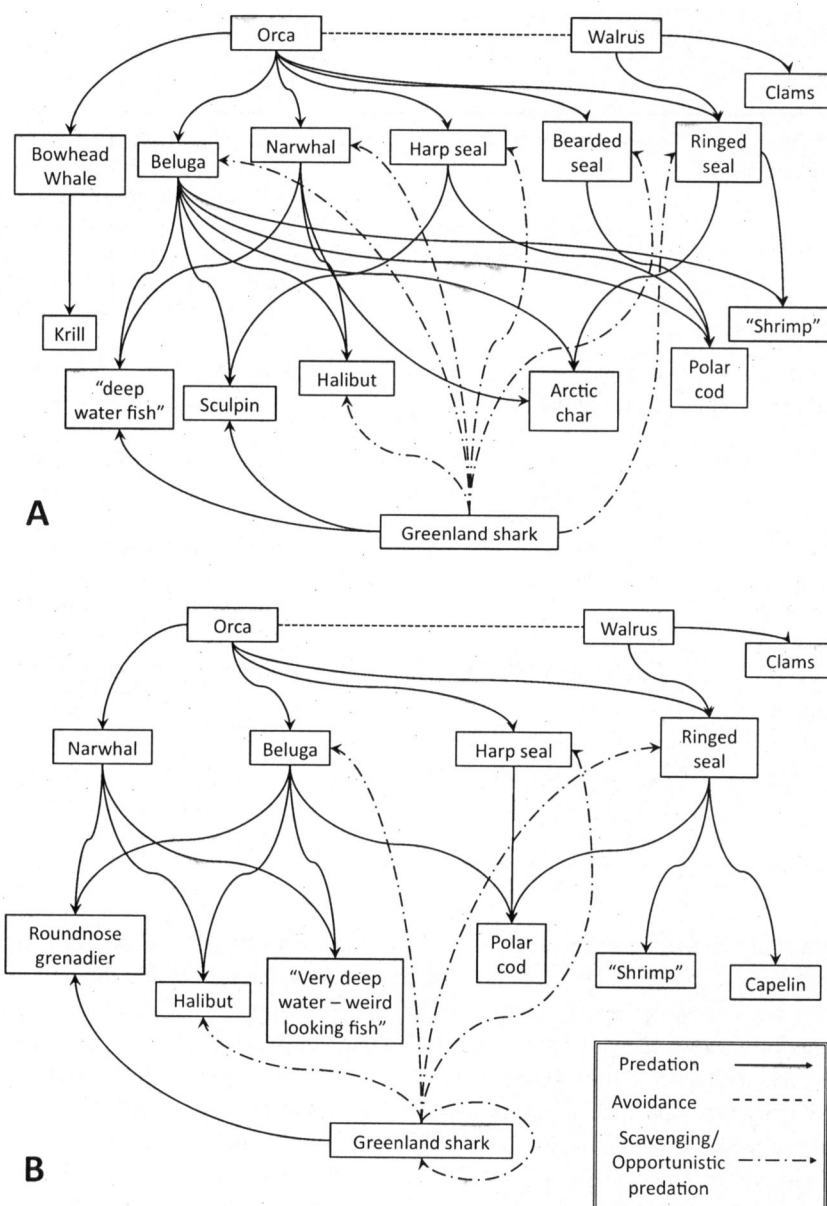
Knowledge Co-production Process about the Greenland Shark

Pangnirtung Inuit ecological knowledge about the Greenland shark interweaves a complex array of predispositions, stored information and conscious guesswork. That sharks are rarely seen, not liked and not used, limits access to experiential information and is a barrier to the emergence of cultural constructions about them. However, the Pangnirtung Inuit do have a body of information about the

Greenland shark, which has grown since the 1990s. Studying the Pangnirtung Inuit ecological knowledge of this species is an opportunity to explore how new knowledge about particular components of the Arctic environment is produced by linking existing scattered pieces of information with the general understanding of the marine ecosystem. Inuit ecological knowledge about the Greenland shark is based on the interaction between two main processes: observation and information processing. Information from the first process is the product of direct contact with sharks. The second process is the outcome of inferences made when available information is examined against existing knowledge.

The experiential knowledge provides community knowledge and the context for examining what the Inuit consider when looking at sharks. Examining how the Inuit interact with the Greenland shark and what they know about it provides a framework to categorize the concepts acting as primers from where ecological knowledge is produced. Observations such as “sharks do not die easy” and “sharks do not have real bones” work to define the distinctiveness of the shark compared to more familiar species, such as polar bears or seals, and the existing relationships between it and people. The Inuit combine the variable “sharks do not die easy” with other general features of “what is considered edible” to tacitly exclude this fish from the local diet (Idrobo

Fig. 1 Species relationships according to two Inuuk hunters, A and B. Species identification is based on photographic examples and regional field guides. Inuit species correspond to the scientific species, except those shown in quotation marks



2008). These two topics allow an understanding of the Greenland shark's quintessence for the Pangnirtung Inuit: this animal is strange and different from other animals that the Pangnirtung Inuit interact with regularly.

Mental processes in processing experiential knowledge reflect how particular shark traits relate to the Inuit worldview, such as what they consider edible. This is an indication of how the Pangnirtung Inuit understanding of sharks seems to follow heuristic thinking, and not just correlating ideas following a linear rationale (Berkas and Kislalioglu Berkas 2009). Sharks' poor eyesight and a strong sense of smell are not considered in isolation. Instead, these understanding about shark characteristics are complexly influenced by what the Inuit consider to be general principles that apply to all sea creatures. When stomach contents are considered, the linkages that emerge take an unexpected

direction. Beyond listing the species found, Inuit comments are mostly centered on the appearance of the items found within stomach contents as related to the stage of digestion. These observations enable people not only to understand the diet of the shark but also to elaborate on direct links between stomach contents and sharks' metabolism and behavior.

There is a common collective understanding among the Pangnirtung Inuit about shark knowledge based on direct observation and experience. However, as bigger sets of variables are required to explain shark ecology, interpretations show variations among participants' responses. These variations suggest that there are some missing steps in the information flow related to the community knowledge repository, which impede the construction of collective models for understanding sharks. An example of this can be seen in the Inuit perception of the sharks' patterns of

abundance. While there was agreement about the times when sharks are caught in the Cumberland Sound, the explanation for these abundance patterns varied. Whether sharks have natural migration patterns, or are permanent dwellers of Cumberland Sound, or are lured to the area by fishing activity are different explanations that, while not excluding each other, do entail using different elements of the observations depending on the contingent experience of each respondent.

Habitat use and feeding behavior are traits not easily observed for the Greenland shark or any deep-water fish species. However, by linking the bits and pieces of accessible information, a strategy was employed by the Inuit to bring together coherent ideas of these features of the shark. The Pangnirtung Inuit consistently used heuristic rules to frame the inference being made about the ecology of the shark. This type of reasoning utilized the form IF *—observation/appreciation—* THEN *—a possible explanation for what is observed* (Grant and Berkes 2007). Variables related to habitat were used to understand feeding behavior. When sharks were perceived as bottom dwellers, they were also perceived to have scavenging behavior. On the other hand, when sharks were perceived to be both bottom dwellers and free swimmers, the understanding of their feeding behavior expanded from exclusive scavenging to include opportunistic predation (Fig. 2).

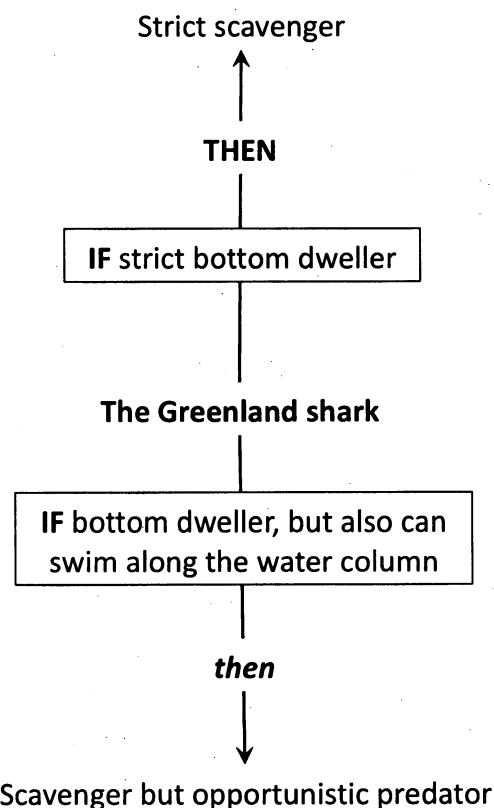


Fig. 2 Shark's feeding behavior relative to habitat use

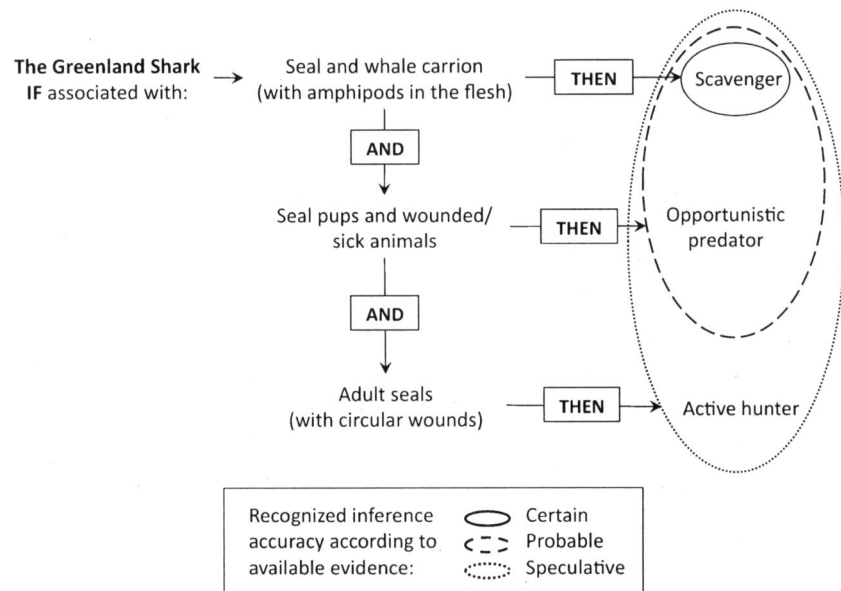
Whether Greenland sharks are strict scavengers or scavengers and opportunistic predators is not clear to the Inuit or to biologists (Skomal and Benz 2004; Yano *et al.* 2007). As such, these two possibilities are used as relative points of view to make further conjectures about shark habitat. While perceiving sharks as strict scavengers allows people to interpret the habitat of this species as being restricted to the sea-bed, seeing sharks as opportunistic predators allows the Inuit to deduce that these fish are more active and able to move freely up and down the water column. This latter option about Greenland shark's habitat has been recently supported by natural scientists using DNA techniques to trace the origins of whale remains found in the gastrointestinal tracks of Greenland sharks (Leclerc *et al.* 2011).

More detailed understandings of the Greenland shark's feeding behavior involve similar processes to the ones mentioned above. Figure 3 illustrates how such reasoning might work. In this case, the available evidence determines the conceptualizations made about the ecological role of the shark. The main body of available evidence, stomach contents of seal and whale remains, leads the Pangnirtung Inuit to hold a core idea about the shark's feeding behavior: this fish is a scavenger. Although this understanding is shared by most of experts interviewed, access to other kinds of information allows some of the local hunters to consider shark feeding behavior within a wider spectrum of possibilities. Those who have found seal pups inside shark stomachs or have come across wounded and sick animals (e.g., seals and whales) with circular teeth marks reason that sharks are probably opportunistic predators. Alternatively, a couple of hunters recall hunting healthy seals with circular wounds on their backs. These hunters speculate that sharks could be active predators capable of preying upon healthy marine mammals. Depending on the available evidence, sharks are identified as probable opportunistic predators by some, and even as occasional active hunters by a smaller minority of hunters.

Discussion and Conclusions

Indigenous knowledge does not encompass all of the species in the environment of any group of people. If the species does not have economic or cultural value the knowledge about it may be fragmentary. Such is the case with the Greenland shark for the Inuit. Bits and pieces of information about the species can be brought together and shared to produce community knowledge. This information can be further interpreted in the light of extensive Inuit knowledge of other species and marine ecosystems. But to the extent that these interpretations overreach observational information, divergences begin to appear, depending on different information held by different Inuit experts.

Fig. 3 Sources of observational information, based on stomach contents, related to variations in the understanding of the feeding behavior of the Greenland shark



What the Pangnirtung Inuit have been able to do is more than the assembling of old observational information and augmenting it with new information that emerged from the halibut fishery by-catch. Inuit knowledge of Greenland shark reported here may be characterized as “new knowledge through a synthesis of what was already known and what was new” (Iskandar and Ellen 2007: 133). The ability of the Inuit to produce such a synthesis of knowledge has implications for research in the areas of disaster (the context of the Iskandar and Ellen quote), vulnerability/resilience (Vogel *et al.* 2007), endangered species (even though the Greenland shark itself is not one of them), and adaptation to environmental change (Peloquin and Berkes 2009). How did the Pangnirtung Inuit produce their shark knowledge?

The use of forms of thought fitting into fuzzy logic and heuristic reasoning are documented in various local and traditional knowledge systems (Nazarea 1998; Mackinson 2000). Fuzzy logic thinking is consistent with how indigenous knowledge provides understandings of the ecosystem according to rules of thumb useful for decision-making (Berkes and Kislalioglu Berkes 2009). Nonetheless, the pertinence of this approach has been assessed only in regards to decision-making systems related to natural resource management, such as fishing in the Northern Atlantic (Mackinson 2000) and the Caribbean (Grant and Berkes 2007), and the selection of potato varieties according to changing environmental conditions in South America (Nazarea 1998).

Fuzzy logic also helps in understanding how traditional knowledge systems work in regards to ecological knowledge production. Indeed, fuzzy logic facilitates understanding the process by which ecological knowledge acquires its holistic sense, providing insights about the organization of general components of nature,

including those for which there are neither experiential nor symbolic interactions. In our research, the Greenland shark becomes the model with which to evaluate how subsets of ecological knowledge are produced within an Inuit worldview. How sharks are thought of both as individual species and as part of the environment proves that, from the perspective of traditional and indigenous knowledge systems, fuzzy logic thinking is not only useful for understanding decision-making systems but also for ecological knowledge production. Even though there are not large amounts of information available about the Greenland shark, the Pangnirtung Inuit explain shark ecology by mobilizing what they understand about the environment in an ever-adaptive fashion.

Contrary to other knowledge subsets in which the Inuit are considered, and consider themselves, experts (for example, sea-ice, Laidler *et al.* 2008), the Greenland shark is something about which the Pangnirtung Inuit know they are not experts. The inquiries brought to Pangnirtung by the research team consisting of natural and social scientists provided the stimuli to entice Inuit research collaborators to think about sharks beyond what they normally would. Hunting and fishing journeys, individual interviews and the focus groups were forums in which the existing knowledge about sharks was mobilized to visualize relationships and elaborate further reflections about the ecology of this species. These conceptualizations occurred because of the interactions triggered by researchers and Inuit participants, allowing the reorganization of information to address bigger ecological questions. This is the essence of knowledge co-production (Armitage *et al.* 2011). Such co-production often involves a forum for social learning, some platform to facilitate the process. In this case, indigenous participants and researchers together constitute this

“community of learning” for the co-production of knowledge (Davidson-Hunt 2006; Robson *et al.* 2009). However, knowledge co-production within such informal learning networks (Goldstein 2008) does not necessarily fill all the information gaps and is not by itself sufficient to make all knowledge uniform. The persistence of knowledge variation among Inuit respondents suggests that information about the Greenland shark is stored in people’s individual memories without being incorporated into a collective cognitive model (Van Londen 1996).

The shark is not normally an object of individual thought, nor is it an object of collective discussion. Although the way of knowing and understanding the environment is collective, the inference processes tend to remain individual, leading to personalized and varied understandings of complex phenomena. Since pooling Greenland shark-related information is not necessary for practical purposes for the Pangnirtung Inuit, this may be a barrier for the emergence of a collective understanding about it. Even though participatory research processes (Davidson-Hunt and O’Flaherty 2007) may serve as a trigger for furthering the emergence of such a collaborative understanding, a consensus on all aspects of that understanding may not emerge in the face of incomplete information.

Acknowledgements We thank the people of Pangnirtung for their contributions to the research and for opening the doors of their world. In particular, we are indebted to the late Noah and Alukie Metuq for home stay, Jaco Ishulutaq and the late Joeelle Papatsie for their teachings during hunting and fishing trips, and Andrew John Dially for translation and acting as community liaison. C.J. Idrobo’s work was supported by a Manitoba Graduate Scholarship; the International Polar Year (IPY) program through a grant to Dr. Aaron Fisk, PI; and the Canada Research Chair (CRC) in Community-based Resource Management. F. Berkes’ work has been supported by the Social Sciences and Humanities Research Council (SSHRC) and the Canada Research Chairs program (<http://www.chairs.gc.ca>).

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